

PATENT SPECIFICATION

DRAWINGS ATTACHED

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COMPLETE SPECIFICATION

Method of, and Apparatus for, Drying Washed Fabrics

We, PROCTOR & SCHWARTZ, INC. a Corporation organised under the laws of Pennsylvania, United States of America with a place of business at 700 Tabor Road, Philadelphia, Pennsylvania, United States of America, do hereby declare the invention, for which we pray that a Patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following Statement:—

This invention relates to a method and apparatus for drying a washed fabric. More particularly the invention relates to a method and apparatus for drying a washed fabric of the kind comprised of a yarn made up at least in part of fibres which are thermoplastic in nature.

A typical fabric of the kind referred to is one wherein the yarns are comprised of a polymer such as "Dacron" (R.T.M.) and a natural fibre such as cotton. Various type of garments are made of such a fabric including, for example, waiter's and barber's coats and also uniforms worn by nurses and hair-dressers. These garments usually are laundered by washing them in a heated wash water including a detergent wherein the temperature of the wash water is maintained at approximately 160°F. or higher to effectively remove dirt and stains. During washing of the garments, the elevated temperature of the wash water and the tumbling of the garment in the confined area of a washing machine, causes the garments to wrinkle. This wrinkling is due to the action of the thermoplastic fibres which, when heated to the wash temperature, are angularly deformed and which characteristically when the garment is dried, tend to set in an angularly deformed condition. At present, after the garments are washed and dried, the garments are pressed to remove wrinkles. In accordance with most high-speed pressing methods, the dried or semi-

dried garment is dressed on a form or dummy and then pressed with conventional ironing apparatus. In order to simplify ironing of the garment, the fashion of the garment is usually very simple having a minimum of pleats and overlap areas. However, even when great care is exercised in the ironing process, portions of the garment which are of double or triple thickness, as for example seams, collars, button and buttonhole strips, are difficult to iron in a manner to remove all wrinkles.

The present invention provides a method and apparatus for drying a washed fabric of the kind referred to so that it is in a substantially wrinkle-free condition without having to iron the same to press out wrinkles in the fabric resulting from washing. To this end, the washed fabric is subjected to a drying medium, the condition of which is controlled in a predetermined manner in relation to the character of the thermoplastic fibres in the fabric and the temperature of the wash water. More specifically in accordance with the present invention, the wet bulb temperature of the drying medium is maintained at a temperature higher than the temperature of the wash water and the dry bulb temperature of the drying medium is maintained at a slightly higher temperature than the wet bulb temperature. By this method, it has been found that after a predetermined drying time, the angular deformation of the thermoplastic fibres in the fabric resulting from washing is removed and the fabric assumes a substantially wrinkle-free condition.

In view of the above, it is readily apparent that laundering garments made of fabric of the kind referred to by the method in accordance with the present invention is more economical and less time consuming by reason of the fact that dressing and undressing of garments on forms or dummies and

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the tedious process of ironing the same is eliminated.

Moreover, the entire garment, including the troublesome portions of thereof which are of double or triple thicknesses, is substantially wrinkle-free. Further by reason of the present invention, it is now possible to fashion garments made of fabric of the kind referred to to include more pleats or overlapping areas since the ironing problem heretofore present, is eliminated. Moreover the life of such garments is extended considerably by eliminating the ironing process.

Other objects of the present invention and the various features and more specific details of the operation of the method and the construction of apparatus in accordance with the present invention are hereinafter more fully set forth with reference to the accompanying drawings, in which:

Figure 1 is a plan partly in section of apparatus for performing the method in accordance with the present invention,

Figure 2 is an enlarged sectional view taken on line 2—2 of Figure 1, and

Figure 3 is a chart of fabric temperature and time in dryer for a particular fabric dried in apparatus according to the present invention.

Referring now to the drawings, there is illustrated a drying apparatus 10 comprising adjacent sections A and B illustrated in Figure 1 which are mounted in end to end relation. The garments G to be dried are suspended from hangers H engageable on hooks depending at spaced locations from a conventional endless conveyor C which transports the garments through the dryer 10 in the direction indicated in Figure 1. Suitable curtain means or the like (not shown) are provided at the entrance and discharge ends of the dryer to minimise leakage of drying medium out of the dryer at the inlet and discharge ends as the garments G to be dried, pass through the dryer.

In the drawings, only the dryer section A is illustrated in detail, the additional sections if desired being of a similar construction. Section A as illustrated, comprises a housing or enclosure 16 including a top wall 18, confronting opposite end walls 20 and 22 and opposing side walls 24 and 26. The interior of the housing 16 is sub-divided into several compartments or zones including a drying chamber 30 extending lengthwise of the dryer and which, as illustrated in Figure 2, is defined by a vertical partition 32 parallel to and spaced from the side wall 26 and spaced upper and lower foraminous partitions 34 and 36. The upper partition 34 is spaced below the top wall 18 to define, in the present instance, a drying medium exhaust manifold 40 above the drying chamber 30 and the lower partition 36 is spaced above the bottom wall of the housing to de-

fine a drying medium inlet manifold 42 below the drying chamber 30.

Means is provided for circulating the drying medium through the drying chamber 30, comprising a fan 50 which communicates with the manifolds 40 and 42 to suck or draw the drying medium from the exhaust manifold 40 and discharge it to the inlet manifold 42. The fan 50 is driven by suitable drive means such as a motor 52 mounted exteriorly of the dryer and connected to the shaft of the fan by suitable belt transmission means. As illustrated, the fan 50 is mounted in a hood structure 53 adjacent to the side of the dryer section opposite the drying chamber 30. The hood structure 53 includes a vertical wall 55 having an opening 57 therein within which the cowl defining the intake of the fan is mounted and a leg portion 59 connecting the discharge side of the fan 50 with the inlet manifold 42.

Means is provided for selectively controlling the condition of the drying medium circulated through the drying chamber 30 so that the wet bulb temperature of the drying medium in the drying chamber 30 is maintained higher than the temperature of the wash water in which the garments G were washed and the dry bulb temperature of the drying medium is maintained at a temperature slightly higher than the wet bulb temperature of the drying medium. To this end there is provided a drying medium conditioning chamber 60 communicating with the exhaust manifold 40 and the intake side of the fan 50 and means in the chamber 60 for conditioning the drying medium including heating means for controlling selectively the dry bulb temperature of the drying medium and a spray unit 70 operable to add moisture selectively to the drying medium for selectively controlling the wet bulb temperature of the drying medium. In the present instance, the heating means comprises a plurality of heating coils 62 adjacent to the top of the conditioning chamber 60 and inlet and outlet conduits 64 and 66 for circulating a heating medium, such as steam there-through, the inlet conduit 64 having valve means 65 for selectively controlling the rate of steam flow through the heating coils. In the present instance, a fine mesh screen 67 is provided at the inlet side of the conditioning chamber 60 to filter out lint and other particles entrained in the drying medium. The spray unit 70 has conduit means 72 for delivering water or steam to the unit and a valve control 74 for selectively controlling the amount of water or steam dispensed by the unit.

Sensing means in the form of a hygrometer 80 is provided in the hood structure 53 downstream of the discharge side of the fan to measure the dry bulb and wet bulb temperatures of the drying medium delivered to the

drying chamber 30. The hygrometer 80 is connected through suitable leads to a control device 81 exteriorly of the dryer housing which device is in turn operatively connected to the valves 65 and 74 for selectively regulating the amounts of heat and moisture imparted to the drying medium for a given setting of the control device. By this arrangement, the control device 81, may be set to regulate the heating means and spray unit to increase or decrease selectively the amount of heat and/or moisture added to the drying medium when the dry bulb and/or wet bulb temperature of the drying medium as sensed by the hygrometer 80 vary from their respective predetermined values.

For example, if the wet bulb temperature of the drying medium is above the predetermined value as sensed by the hygrometer 80, the control device 81 is signalled and operates the valve 74 to reduce the amount of moisture added to the drying medium. Conversely, if the wet bulb temperature of the drying medium is less than the predetermined value, the control device 81 effects operation of the valve 74 to increase the amount of moisture added to the drying medium to raise the wet bulb temperature to the predetermined value. Further if the dry bulb temperature of the drying medium is greater than the predetermined value as sensed by the hygrometer 80, the control device 81 is signalled to effect actuation of the valve 65 to decrease flow through the heating coils 62 until the dry bulb temperature is brought down to the predetermined value. If the dry bulb temperature is less than the predetermined value, the control device 81 is signalled through the hygrometer 80 to increase flow through the heating coils 62 to raise the dry bulb temperature to the predetermined value.

Tracing now the flow pattern of the drying medium through the dryer and starting at the exhaust manifold 40, drying medium circulated through the drying chamber enters the exhaust manifold 40 and is drawn through the conditioning chamber 60 by the fan 50. An outlet 82 may be provided in the exhaust manifold 40 which has a damper 84 selectively adjustable to vent some of the drying medium to the atmosphere. The fan 50 discharges the drying medium through the leg portion of the hood 53 to the air inlet manifold. The hygrometer 80 measures the conditions of the drying medium and if the dry bulb and/or wet bulb temperature of the drying medium vary from the selected settings on the control device 81, the control device effects actuation of the control valve 65 for the heating coils and/or the control valve 74 for the spray unit to compensate for deviation from the selected conditions. By this arrangement, the medium circulated through the drying chamber may be main-

tained at a preselected substantially uniform dry and wet bulb temperature whereby when the garments G have been in the drying chamber a predetermined length of time, they are dried to a substantially wrinkle-free condition.

Operation of the dryer is further illustrated, but not limited, by the following example. Coats made of a fabric comprising 65% "Dacron" and 35% cotton were washed in a wash water having a temperature of approximately 160°F. After washing, the coats which had a moisture content in the vicinity of 83% RDB (bone dry basis) were placed on hangers and suspended from the conveyor G and then run through the dryer. The control device 81 was set to effect circulation of a drying medium through the drying chamber 30 having a wet bulb temperature slightly higher than the wash temperature of the garments approximately 175°F. and a dry bulb higher than the wet bulb temperature approximately 225°F. The dry bulb temperature should of course be lower than the degradation temperature of the thermoplastic fibres. Under these conditions, the drying medium was circulated through the drying chamber 30 upwardly through the coats, the air circulation in the chamber being in the neighbourhood of 300 feet per minute. The circulation of drying medium upwardly through the coats at this velocity effected agitation and ballooning of the coats thereby enhancing drying thereof to a wrinkle-free condition. It will be seen from Figure 3 that by subjecting the coats G to moist heat the temperature of the coats was raised quickly from approximately 70°F. when they entered the dryer to a temperature of approximately 175°F., which is above the wash temperature, whereby the set, in the thermoplastic fibres put in during the wash operation may be removed. It is noted that the temperature of the coats dropped from approximately 160°F., the temperature of the wash water, to approximately 70°F. during the time the coats were removed from the washer, were permitted to drip dry a short period of time and were then conveyed through the drying apparatus. Further, it is noted that the coats G stayed at approximately 175°F. for approximately eight minutes during movement through the drying apparatus, during which time the free moisture was removed from the coats. In this manner, the wet bulb temperature of the fibres of the coats was in a desired condition for wrinkle removal. After the free moisture had been removed, the temperature of the coats gradually rose as shown on the chart in Figure 3. When the coats had been subjected to a drying medium in the drying chamber a predetermined length of time, from 13 to 15 minutes, the temperature of the material in the coats was approximately 220°F. as shown

on the chart in Figure 3, and the coats had dried to a substantially wrinkle-free condition. After the coats had been discharged from the dryer, they were permitted to cool before being removed from the hangers H.

It is noted that the method of the present invention is not limited to the example noted above, but to any fabric comprised of a blend of thermoplastic of fibres, for example "Dacron" and other textile fibres, either natural fibres such as cotton, or synthetic fibres such as nylon. These blends and the relative ratio of the thermoplastic and textile fibres may cover a wide range.

15 WHAT WE CLAIM IS:—

1. A method of drying fabric washed in a heated liquid, which fabric is comprised of yarns including at least some thermoplastic fibres, comprising the steps of freely suspending the fabric, subjecting the suspended fabric to a drying medium and controlling the condition of the drying medium so that its wet bulb temperature is higher than the temperature of the liquid in which the fabric was washed and its dry bulb temperature is higher than the wet bulb temperature whereby the fabric is dried to a wrinkle-free condition.

2. The method claimed in claim 1, in which the fabric is subjected to the drying medium while it is conveyed through a substantially enclosed drying chamber.

3. The method claimed in claim 2 in which the drying medium is circulated through the fabric at a rate to cause agitation thereof.

4. The method claimed in claim 2 or 3, in which the fabric is maintained in the drying chamber a predetermined length of time sufficient to raise the temperature of the fabric approximately to the dry bulb temperature of the drying medium whereby the bound and free moisture therein is removed.

5. The method claimed in any one of claims 2 to 4, comprising adding heat and moisture to the drying medium circulated through the drying chamber, sensing the dry bulb and wet bulb temperature of the drying medium prior to circulation thereof through the drying chamber and selectively varying the amount of heat and moisture added to the drying medium to maintain the wet bulb temperature thereof higher than the temperature of the liquid in which the fabric was washed and its dry bulb temperature higher than the wet bulb temperature.

6. Apparatus for drying fabric washed in a liquid having a predetermined temperature, said fabric being comprised of yarns including at least some thermoplastic fibres, the apparatus comprising a drying chamber for the washed fabric, means for circulating a drying medium through said drying chamber and control means for maintaining the wet bulb temperature of the drying medium at

a higher temperature than the predetermined temperature of the wash liquid and the dry bulb temperature of the drying medium higher than the wet bulb temperature.

7. Apparatus as claimed in claim 6, including means for freely suspending the fabric in said drying chamber.

8. Apparatus as claimed in claim 7, including conveyor means for conveying the suspended fabric through said drying chamber.

9. Apparatus as claimed in claim 8, comprising of a drying medium conditioning chamber communicating with said drying chamber, means for circulating the drying medium through said drying and conditioning chambers, heating means in said conditioning chamber for heating the drying medium, and means in said conditioning chamber for adding moisture to the drying medium, said control means selectively controlling the amount of heat and moisture added to the drying medium in the conditioning chamber so that the wet bulb temperature of the drying medium circulated through the drying chamber is maintained at a higher temperature than the predetermined temperature of the wash liquid and the dry bulb temperature of the drying medium is maintained at a temperature higher than the wet bulb temperature.

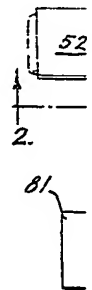
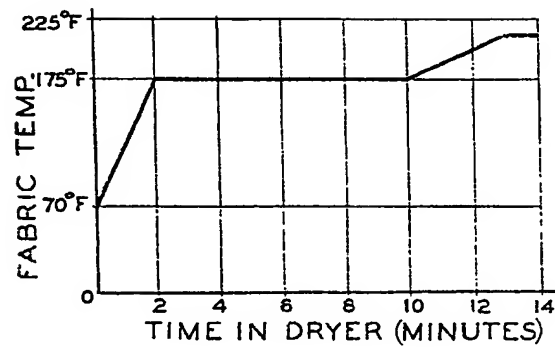
10. Apparatus as claimed in claim 9, in which said circulating means comprises a fan operable to draw the drying medium through the conditioning chamber and deliver it to the drying chamber.

11. Apparatus as claimed in claim 10, including sensing means for sensing the condition of the drying medium delivered by said fan to the drying chamber.

12. Apparatus for drying fabric washed in a liquid having a predetermined temperature, said fabric comprised of yarns including at least some thermoplastic fibres, the apparatus comprising a drying chamber, means for conveying freely suspended fabric through said drying chamber, a drying medium conditioning chamber communicating with said drying chamber, means for circulating a drying medium through said drying and conditioning chambers, a hygrometer operable to measure the dry and wet bulb temperature of the drying medium delivered to said drying chamber, heating means in said conditioning chamber for heating the drying medium comprising a plurality of heating coils and conduit means including a valve for controlling amount of a heating fluid circulated through said coils, means in said conditioning chamber for adding moisture to the drying medium comprising a spray unit including valve means for selectively controlling flow of liquid thereto and a control device operatively connected to said valve control means for said heating coils

- and said spray unit and said hygrometer operable to regulate through said valve controls the amount of heat and moisture added to said drying medium in response to changes in said wet and dry bulb temperature from a predetermined wet and dry bulb temperature of the drying medium whereby the drying medium circulated through said drying chamber may be maintained at a wet bulb temperature greater than the temperature of the wash liquid and the dry bulb temperature may be maintained higher than the wet bulb temperature.
13. Apparatus for drying washed fabric constructed and arranged substantially as herein described with reference to the accompanying drawing.
14. A method of drying garments washed in a heated liquid, which garment is made of a fabric comprised of yarns including at least some thermoplastic fibres consisting of the steps of freely suspending the garment, conveying the garment through a substantially enclosed drying chamber, circulating a drying medium upwardly through the garment at a rate to cause agitation and ballooning thereof and controlling the condition of the drying medium so that its wet bulb temperature is higher than the temperature of the liquid in which the garment was washed and its dry bulb temperature is higher than the wet bulb temperature whereby the garment is dried to a wrinkle-free condition.
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FIG.3.

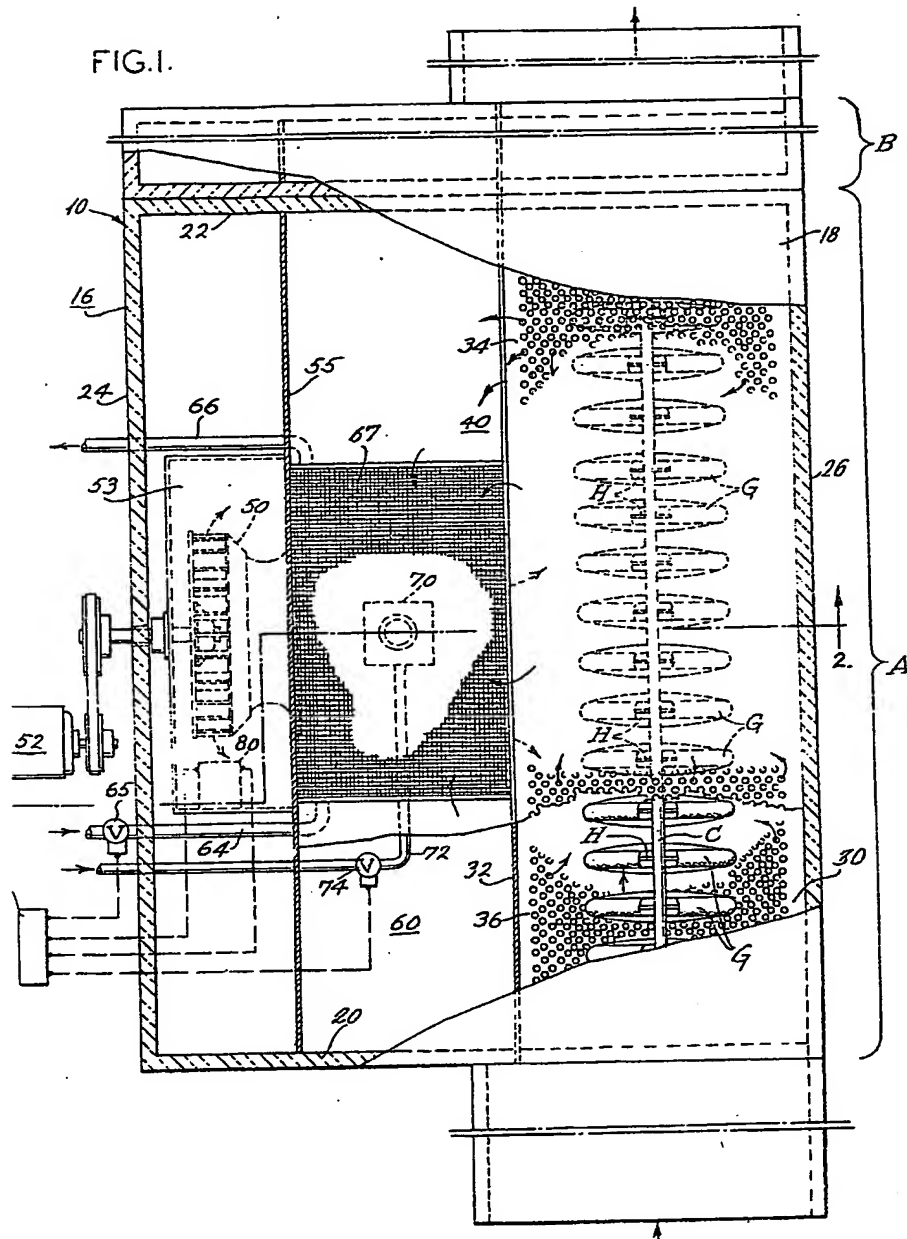


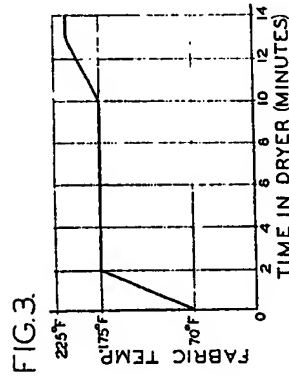
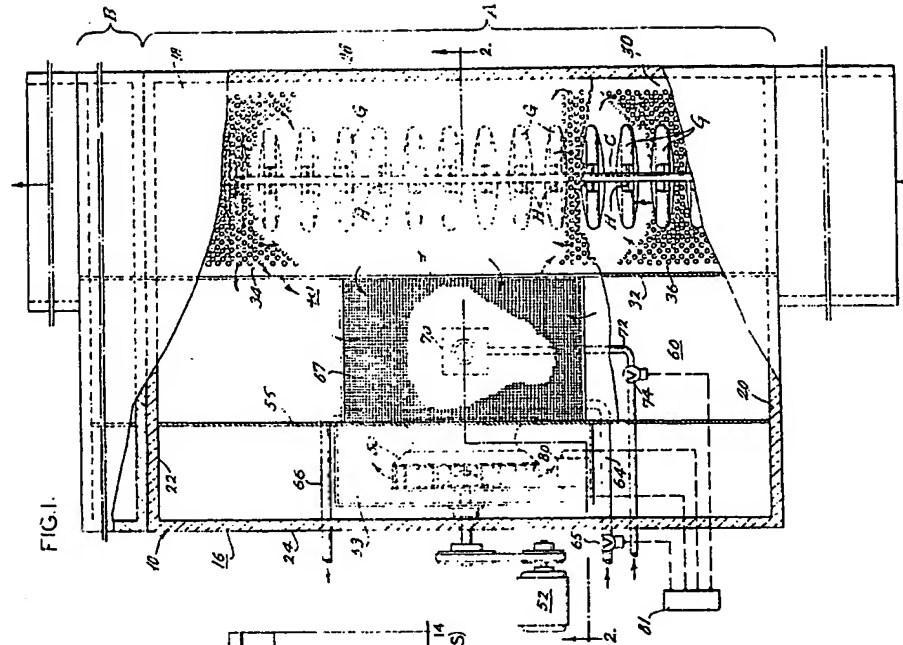
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COMPLETE SPECIFICATION

2 SHEETS

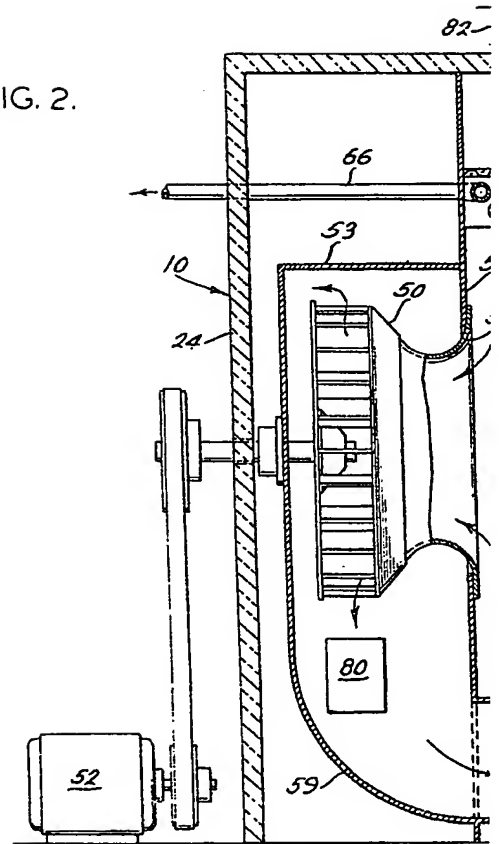
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the Original on a reduced scale
Sheet 1





POOR QUALIT

FIG. 2.



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